

**IN THE CLAIMS:**

1       1. (Currently Amended) A method for a storage operating system implemented in a  
2       storage system to optimize the amount of readahead data retrieved for a read stream es-  
3       tablished in a data container stored in the storage system, the method comprising:

4               receiving a client read request at the storage system, the client read request indi-  
5       cating client-requested data for the storage operating system to retrieve from the data  
6       container containing the read stream;

7               determining whether the storage operating system is permitted to retrieve reada-  
8       head data from the data container in response to the received client read request;

9               if it is determined that the storage operating system is permitted to retrieve reada-  
10      head data from the data container, performing the steps of:

11               (i)       selecting an amount of readahead data to retrieve from the data container  
12               |        based on a plurality of factors stored within a readset data structure associ-  
13               |        ated with the read stream; and  
14               (ii)      retrieving the selected amount of readahead data from the data container.

1       2. (Original) The method of claim 1, wherein the data container is a file, directory, vdisk  
2       or lun.

1       3. (Original) The method of claim 1, wherein the storage operating system is determined  
2       to be permitted to retrieve readahead data from the data container when the client-  
3       requested data extends the read stream past a predetermined next readahead value.

1       4. (Original) The method of claim 3, wherein the predetermined next readahead value is  
2       stored in a readset data structure associated with the read stream.

- 1    5. (Original) The method of claim 3, wherein the predetermined next readahead value is
- 2    updated based on a percentage of the selected amount of readahead data.
  
- 1    6. (Previously Presented) The method of claim 1, wherein a read-access style associated
- 2    with the data container is one of the plurality of factors used to select the amount of
- 3    readahead data.
  
- 1    7. (Original) The method of claim 6, wherein the selected amount of readahead data
- 2    equals zero if the read-access style corresponds to a random read-access style.
  
- 1    8. (Previously Presented) The method of claim 1, wherein a number of client read re-
- 2    quests processed in the read stream is one of the plurality of factors used to select the
- 3    amount of readahead data.
  
- 1    9. (Original) The method of claim 8, wherein the number of client read requests proc-
- 2    essed in the read stream is stored as a count value in a readset data structure associated
- 3    with the read stream.
  
- 1    10. (Previously Presented) The method of claim 1, wherein the amount of client-
- 2    requested data is one of the plurality of factors used to select the amount of readahead
- 3    data.
  
- 1    11. (Original) The method of claim 10, wherein the selected amount of readahead data is
- 2    set equal to a predetermined upper limit for large amounts of client-requested data.
  
- 1    12. (Original) The method of claim 1, wherein the selected amount of readahead data is
- 2    doubled if the number of client read requests processed in the read stream is greater than
- 3    a first threshold value.

1       13. (Original) The method of claim 1, wherein the client-requested data is identified as  
2       read-once data when either (i) the number of client read requests processed in the read  
3       stream is greater than a second threshold value or (ii) a set of metadata associated with  
4       the read stream indicates that the client-requested data is read-once data.

1       14. (Original) The method of claim 1, wherein the selected amount of readahead data is  
2       stored in one or more buffers enqueued on a flush queue, the flush queue being config-  
3       ured to reuse buffers after a predetermined period of time.

1       15. (Original) The method of claim 14, wherein the predetermined period of time equals  
2       two seconds.

1       16. (Currently Amended) An apparatus configured to implement a storage operating sys-  
2       tem that optimizes the amount of readahead data retrieved for a read stream established in  
3       a data container stored in the apparatus, the apparatus comprising:

4               means for receiving a client read request, the client read request indicating client-  
5       requested data for the storage operating system to retrieve from the data container con-  
6       taining the read stream;

7               means for determining whether the storage operating system is permitted to re-  
8       trieve readahead data from the data container in response to the received client read re-  
9       quest;

10          means for selecting an amount of readahead data to retrieve from the data con-  
11       tainer based on a plurality of factors stored within a readset data structure associated with  
12       the read stream; and

13          means for retrieving the selected amount of readahead data from the data con-  
14       tainer.

1       17. (Original) The apparatus of claim 16, wherein the data container is a file, directory,  
2       vdisk or lun.

- 1        18. (Original) The apparatus of claim 16, wherein the storage operating system is deter-  
2        mined to be permitted to retrieve readahead data from the data container when the client-  
3        requested data extends the read stream past a predetermined next readahead value.
- 1        19. (Original) The apparatus of claim 18, further comprising means for updating the pre-  
2        determined next readahead value based on a percentage of the selected amount of reada-  
3        head data.
- 1        20. (Previously Presented) The apparatus of claim 16, wherein the plurality of factors  
2        used to select the amount of readahead data includes at least one of:
  - 3            (i) the amount of client-requested data,
  - 4            (ii) a number of client read requests processed in the read stream, and
  - 5            (iii) a read-access style associated with the data container.
- 1        21. (Original) The apparatus of claim 16, wherein the selected amount of readahead data  
2        is doubled if the number of client read requests processed in the read stream is greater  
3        than a first threshold value.
- 1        22. (Currently Amended): A storage system configured to optimize the amount of reada-  
2        head data retrieved for a read stream established in a data container stored in the storage  
3        system, the storage system comprising:
  - 4            a network adapter for receiving a client read request, the client read request indic-  
5            ating client-requested data to retrieve from the data container containing the read stream;
  - 6            and
  - 7            a memory configured to store instructions for implementing a storage operating  
8            system that performs the steps of:
    - 9              determining whether the storage operating system is permitted to retrieve  
10             readahead data from the data container in response to the received client read re-  
11             quest, and

12           if it is determined that the storage operating system is permitted to retrieve  
13           readahead data from the data container:

14                 (i)       selecting an amount of readahead data to retrieve from the  
15                data container based on a plurality of factors stored within a readset data  
16               structure associated with the read stream; and

17                 (ii)      retrieving the selected amount of readahead data from the  
18                data container.

1     23. (Original) The storage system of claim 22, wherein the data container is a file, direc-  
2     tory, vdisk or lun.

1     24. (Original) The storage system of claim 22, wherein the storage operating system is  
2     determined to be permitted to retrieve readahead data from the data container when the  
3     client-requested data extends the read stream past a predetermined next readahead value.

1     25. (Original) The storage system of claim 24, wherein the predetermined next reada-  
2     head value is updated based on a percentage of the selected amount of readahead data.

1     26. (Previously Presented) The storage system of claim 22, wherein the plurality of fac-  
2     tors used to select the amount of readahead data includes at least one of:

3                 (i) the amount of client-requested data,  
4                 (ii) a number of client read requests processed in the read stream, and  
5                 (iii) a read-access style associated with the data container.

1     27. (Original) The storage system of claim 22, wherein the selected amount of readahead  
2     data is doubled if the number of client read requests processed in the read stream is  
3     greater than a first threshold value.

1        28. (Currently Amended) A computer-readable media comprising instructions for execu-  
2        tion in a processor for the practice of a method for a storage operating system imple-  
3        mented in a storage system to optimize the amount of readahead data retrieved for a read  
4        stream established in a data container stored in the storage system, the method compris-  
5        ing:

6                receiving a client read request at the storage system, the client read request indi-  
7        cating client-requested data for the storage operating system to retrieve from the data  
8        container containing the read stream;

9                determining whether the storage operating system is permitted to retrieve reada-  
10      head data from the data container in response to the received client read request;

11                if it is determined that the storage operating system is permitted to retrieve reada-  
12      head data from the data container, performing the steps of:

- 13                (i)        selecting an amount of readahead data to retrieve from the data container  
14                based on a plurality of factors stored within a readset data structure associ-  
15                ated with the read stream; and
- 16                (ii)      retrieving the selected amount of readahead data from the data container.

1        29. (Original) The computer-readable media of claim 28, wherein the data container is a  
2        file, directory, vdisk or lun.

1        30. (Previously Presented) The method of claim 1, wherein the retrieved readahead data  
2        is stored in one or more buffers, the buffers containing a flush queue, the flush queue be-  
3        ing configured to reuse buffers after a predetermined period of time.

1        31. (Previously Presented) The method of claim 30, wherein the read stream corresponds  
2        to a read-once data transfer and data retrieved from the data container is stored in the  
3        flush queue.

1    32. (Previously Presented) The method of claim 30, wherein the retrieved readahead data  
2    is stored in the flush queue.

1    33. (Previously Presented) The method of claim 30, wherein one or more buffers ac-  
2    cessed from the flush queue are re-enqueued on a normal queue.

1    34. (Currently Amended) A method for optimizing readahead data retrieval for a read  
2    stream established in a data container stored in a storage system, the method comprising:  
3         receiving a client read request at the storage system, the client read request be-  
4         longing to the read stream and indicating an amount of client-requested data;  
5         selecting an amount of readahead data based on the indicated amount of client-  
6         requested data stored within a readset data structure associated with the read stream; and  
7         retrieving the selected amount of readahead data from the data container.

1    35. (Previously Presented) The method of claim 34, wherein the selected amount of  
2    readahead data is set equal to a multiple of a predetermined amount, and wherein the  
3    multiple is associated with the amount of client-requested data.

1    36. (Previously Presented) The method of claim 34, wherein the selected amount of  
2    readahead data is set equal to a multiple of the amount of client-requested data.

1    37. (Previously Presented) The method of claim 36, further comprising the step of  
2    rounding the selected amount of readahead data to the size of a data block.

1    38. (Previously Presented) The method of claim 34, wherein the selected amount of  
2    readahead data is set equal to a predetermined upper limit.

1    39. (Currently Amended) A method for optimizing readahead data retrieval for a read  
2    stream established in a data container stored in a storage system, the method comprising:

3 receiving a client read request at the storage system, the client read request be-  
4 longing to the read stream and indicating client-requested data;  
5 selecting an amount of readahead data based on a read-access style associated  
6 with the data container, wherein the read-access style is stored within a readset data struc-  
7 ture associated with the read stream; and  
8 retrieving the selected amount of readahead data from the data container.

1 40. (Previously Presented) The method of claim 39, wherein the selected amount of  
2 readahead data equals zero if the read-access style corresponds to a random read-access  
3 style.

1 41. (Previously Presented) A method for optimizing readahead data retrieval for a read  
2 stream established in a data container stored in a storage system associated with a number  
3 of storage devices, the method comprising:

4 receiving a client read request at the storage system, the client read request be-  
5 longing to the read stream and indicating client-requested data;  
6 selecting an amount of readahead data based on the number of storage devices;  
7 and  
8 retrieving the selected amount of readahead data from the data container.

1 42. (Previously Presented) The method of claim 41, wherein the step of selecting an  
2 amount of readahead data further comprises:

3 determining whether a flag is associated with the read stream, the flag indicating  
4 that the storage system is associated with more than a predetermined number of storage  
5 devices; and  
6 in response to determining whether the flag is associated, selecting the amount of  
7 readahead data.

- 1    43. (Previously Presented) The method of claim 41, wherein the storage devices com-
- 2    prise one or more disks.
  
- 1    44. (Currently Amended) A method for optimizing readahead data retrieval for a read
- 2    stream established in a data container stored in a storage system, the method comprising:
  - 3        receiving a client read request at the storage system, the client read request be-
  - 4        longing to the read stream and indicating client-requested data;
  - 5        selecting an amount of readahead data based on a plurality of factors stored within
  - 6        a readset data structure associated with the read stream; and
  - 7        retrieving the selected amount of readahead data from the data container.
  
- 1    45. (Previously Presented) The method of claim 44, wherein the retrieved readahead
- 2    data is stored in one or more buffers, the buffers containing a flush queue, the flush queue
- 3    being configured to reuse buffers after a predetermined period of time.
  
- 1    46. (Previously Presented) The method of claim 45, wherein the read stream corre-
- 2    sponds to a read-once data transfer and data retrieved from the data container is stored in
- 3    the flush queue.
  
- 1    47. (Previously Presented) The method of claim 45, wherein the retrieved readahead
- 2    data is stored in the flush queue.
  
- 1    48. (Previously Presented) The method of claim 45, wherein one or more buffers ac-
- 2    cessed from the flush queue are re-enqueued on a normal queue.
  
- 1    49. (Currently Amended) A system for optimizing readahead data retrieval for a read
- 2    stream established in a data container stored in a storage system, the system comprising:
  - 3        means for receiving a client read request at the storage system, the client read re-
  - 4        quest belonging to the read stream and indicating client-requested data;

5       means for selecting an amount of readahead data based on a plurality of factors  
6   stored within a readset data structure associated with the read stream; and  
7       means for retrieving the selected amount of readahead data from the data con-  
8   tainer.

1   50. (Previously Presented) The system of claim 49, wherein the retrieved readahead data  
2   is stored in one or more buffers, the buffers containing a flush queue, the flush queue be-  
3   ing configured to reuse buffers after a predetermined period of time.

1   51. (Previously Presented) The system of claim 50, wherein the read stream corresponds  
2   to a read-once data transfer and data retrieved from the data container is stored in the  
3   flush queue.

1   52. (Previously Presented) The system of claim 50, wherein the retrieved readahead data  
2   is stored in the flush queue.

1   53. (Previously Presented) The system of claim 50, wherein one or more buffers ac-  
2   cessed from the flush queue are re-enqueued on a normal queue.

1 Please add new claims 54 *et al.*

1 54. (New) A method, comprising:

2 receiving a plurality of client read requests at a storage system, the client read re-  
3 quests indicating client-requested data sets for a storage operating system to retrieve from  
4 one or more data containers containing one or more read streams;

5 selecting an amount of readahead data to retrieve from the one or more data con-  
6 tainers based on a plurality of factors stored within a readset data structure associated  
7 with each read stream;

8 retrieving the selected amount of readahead data from the data container;

9 processing one or more of the plurality of client read requests; and

10 adjusting, as client requests are processed, the plurality of factors stored within  
11 the readset data structure associated with each read stream to optimize amount of reada-  
12 head data is cached for each read stream.

1 55. (New) The method of claim 54, further comprising:

2 determining whether the storage operating system is permitted to retrieve reada-  
3 head data from the one or more data containers in response to each received client read  
4 request.

1 56. (New) The method of claim 54, wherein the one or more data containers are at least  
2 one of a file, a directory, a vdisk or a lun.

1 57. (New) The method of claim 55, wherein the storage operating system is determined  
2 to be permitted to retrieve readahead data from the one or more data containers when the  
3 client-requested data extends the read stream past a predetermined next readahead value.

1 58. (New) The method of claim 57, wherein the predetermined next readahead value is  
2 stored in a readset data structure associated with the read stream.

- 1    59. (New) The method of claim 57, wherein the predetermined next readahead value is
- 2    updated based on a percentage of the selected amount of readahead data.
  
- 1    60. (New) The method of claim 54, wherein a read-access style associated with the one
- 2    or more data containers is one of the plurality of factors used to select the amount of
- 3    readahead data.
  
- 1    61. (New) The method of claim 60, wherein the selected amount of readahead data equals
- 2    zero if the read-access style corresponds to a random read-access style.
  
- 1    62. (New) The method of claim 54, wherein a number of client read requests processed
- 2    in the read stream is one of the plurality of factors used to select the amount of readahead
- 3    data.
  
- 1    63. (New) The method of claim 62, wherein the number of client read requests processed
- 2    in the read stream is stored as a count value in a readset data structure associated with the
- 3    read stream.
  
- 1    64. (New) The method of claim 54, wherein the amount of client-requested data is one
- 2    of the plurality of factors used to select the amount of readahead data.
  
- 1    65. (New) The method of claim 64, wherein the selected amount of readahead data is set
- 2    equal to a predetermined upper limit for large amounts of client-requested data.
  
- 1    66. (New) The method of claim 54, wherein the selected amount of readahead data is
- 2    doubled if the number of client read requests processed in the read stream is greater than
- 3    a first threshold value.

- 1    67. (New) The method of claim 55, wherein the client-requested data is identified as
- 2    read-once data when either (i) the number of client read requests processed in the read
- 3    stream is greater than a second threshold value or (ii) a set of metadata associated with
- 4    the read stream indicates that the client-requested data is read-once data.

  

- 1    68. (New) The method of claim 54, wherein the selected amount of readahead data is
- 2    stored in one or more buffers enqueued on a flush queue, the flush queue being config-
- 3    ured to reuse buffers after a predetermined period of time.